REMARKS

Status of the Claims

Claims 1, 3-8, 10-25, 27-49 and 52 are currently pending. Claims 29-47 have been withdrawn as being drawn to nonelected inventions. In this Response, claims 1, 27 and 28 are amended to clarify the invention, and claims 19-21 are canceled without prejudice or disclaimer. Support for this amendment is found in the specification as filed at page 10, lines 18-20, page 11, lines 25-27, and in original claims 19-21, which are now canceled. Following entry of the amendment, claims 1, 3-8, 10-18, 22-25, 27, 28, 48-49 and 52 will remain pending and subject to further examination. Entry of the amendment and reconsideration of the claims in view of the following comments are respectfully requested.

Rejections under 35 U.S.C. § 103

Claims 1, 3-8, 10-25, 27, 28, 48-49 and 52 stand rejected under 35 U.S.C. § 103(a) as allegedly being obvious over Craig (US 5,792,943, hereinafter "Craig") in view of Goedert (US 4,935,040, hereinafter "Goedert").

Regarding independent claims 1, 27 and 28, Craig allegedly discloses a gas chromatograph column (col. 12, l. 54 - col. 13, l. 1), which column comprises more than two lid layers and more than one channel layer (col. 4, l. 41-47 and fig. 6a-6b), wherein each of said layers comprises a compact material (see "substrate material", col. 5, l. 1-8) suitable for gas chromatography (col. 12, l. 54 - col. 13, l. 1), said channel layers comprise microfabricated channels on both sides (col. 17, l. 8-11, and fig. 6a-6b) and a side of said lid layers form at least four capillaries ("channel 260", "channel 262", fig. 6a-6b and col. 4, l. 41-47), said at least four capillaries are connected to each other through a hole in said channel layer to form an integrated capillary ("conduit means 272", fig. 6a-6b), said integrated capillary is connected to outside atmosphere on both ends via holes on two outmost lid layers (implicitly disclosed in fig. 6a-6b) to serve as an inlet and an outlet ("aperture 270", "aperture 278", fig. 6a-6b).

The Office acknowledges that Craig fails to explicitly disclose a gas chromatograph column wherein said lid layers and channel layers are discrete lid and channel layers. To cure this deficiency of Craig, the Office cites Goedert, which allegedly discloses a miniature gas chromatography column (abstract) comprising a plurality of discrete lid and channel layers (fig. 1) in order to form a unitary body having aligned chromatographic micro-columns (col. 4, l. 61-64) and "to allow separate fabrication of said lid and channel layers (implicitly disclosed)". The Office argues that "it would have been obvious at the time of the invention to combine the discrete lid and channel layer teachings of Goedert with the gas chromatograph column of Craig to allow separate fabrication of the lid and channel layers, thereby increasing the scale and ease of production of such gas chromatograph columns". Further, the Office argues that "while Craig fails to explicitly disclose discrete lid and channel layers, it would have been obvious to one having ordinary skill in the art at the time of invention to separate the lid and channel layers of Craig, since it has been held that constructing a formerly integral structure in various elements involves only routine skill in the art (MPEP 2144.04, Section V, Part C)".

As an initial matter, independent claims 1, 27 and 28 have been amended to specify that the wall of the integrated capillary is coated with a thin film of a stationary phase by depositing the stationary phase on the walls of the microfabricated channels and corresponding regions of the lid layers before the channel and lid layers are bound together. As noted above, support for this amendment is found in the specification as filed at page 10, lines 18-20, page 11, lines 25-27, and in original claims 19-21, which are now canceled. All the remaining claims incorporate the same limitation by virtue of being dependent on one of the amended base claims.

The newly added limitation is significant for the following reason. The smoothness of the stationary phase coating the inside of a capillary column is a function of the profile symmetry. The uniformity of coating thickness is extremely important to maintain sharp separation peaks. The micromachined gas chromatography columns described in the prior art usually consist of a cover sheet of Pyrex glass that is anodically bonded to a U-shaped, V-shaped, or rectangular groove etched in Si. Columns also have been made by joining to U-grooved halves. All these designs have a major potential deficiency because they tend to accumulate coating on the corners or joints,

leading to a suboptimal separation. Analytes spend a longer time in areas where the coating is thick, compared with places where it is thin, leading to a broadening of peaks. *See, e.g.*, M. J. Madou, "FUNDAMENTALS OF MICROFABRICATION: THE SCIENCE OF MINIATURIZATION," Chapter 10: Miniaturization Applications, 2nd ed., CRC Press, 2002 (attached herewith as ***Exhibit A***), at page 653, right col. Applicants discovered that pre-coating the microchannels with a stationary phase before the layers are bonded together solves the problem of uneven coating because the stationary phase liquid used for the coating never comes in contact with the joints before it dries up.

A careful reading of Craig and Goedert reveals that neither reference teaches or even suggests the newly added limitation. In the present Office Action, the Examiner refers to Craig at cols. 13:42-54 and 20:33-35 (Example 1) as allegedly disclosing the additional limitations of claims 19-21. For convenience, these passages of Craig are reproduced below in their entirety:

> The term "surface treatment" is used to refer to preparation or modification of the surface of a component section, and in particular of a channel which will be in contact with a sample during separation, whereby the characteristics of the surface are altered or otherwise enhanced. Accordingly, "surface treatment" as used herein includes: physical surface coatings such as silication or silane coatings; physical surface adsorptions; covalent bonding of selected moieties to functional groups on the surface of channel substrates; methods of coating surfaces, including dynamic deactivation of channel surfaces, substrate grafting to the surface of channel substrates, and thin-film deposition of materials such as diamond or sapphire to channel substrates. (Craig at col. 13:42-54).
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> The column included a packed stationary phase composed of 80/100 HayesSep Poraplot Q. (Craig at col. 20:33-35).

Based on these passages, Craig clearly fails to disclose that the wall of the integrated capillary is coated with a thin film of a stationary phase by depositing the stationary phase on the walls of the microfabricated channels and corresponding regions of the lid layers before the channel and lid layers are bound together, as required in claims 1, 27 and 28.

Goedert also contains several passages discussing a "stationary phase," none of which appears to teach or even suggest the newly added limitation of claims 1, 27 and 28:

> Preferably the stationary phase is a liquid phase. In a further embodiment, the body is formed of at least two adjacent wafer members laminated together including a first wafer member with a first surface and a second wafer member with a second surface bonded to the first surface. The first surface has therein a first serpentine groove and the second surface has therein a second serpentine groove in alignment with the first groove so as to define a serpentine channel in the body. (Goedert at col. 3:1-10).
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> With reference again to FIG. 1, a plurality of wafer pairs 14 are stacked and laminated together so as to form a unitary body 24 and to generally align a corresponding plurality of chromatographic micro-columns 22 (four shown). Bonding is effected as described above for each pair of wafers. The columns may be of various dimensions and contain selected stationary liquid phases, as required for simple or complex chromatography. For example, a typical stationary phase may be bonded methyl silicon, or bonded Carbowax (TM), or the like. (Goedert at cols. 4:61-5:2).
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> Generally a gas chromatographic column is coated with a stationary phase, which can be an absorbent of a liquid, and as a result of the solution-dissolution process of the solute molecules into and out of the stationary phase, solute retention and resolution in the column are obtained. Preferably, in the present device, this is a liquid phase coating of a type such as described above with respect to Planar Columns, on the inside walls of column 22. According to a preferred embodiment of the present invention, detector cavity 149 (FIG. 9) with associated components including bridge 168 for resistive film 166 is juxtaposed with the gas outlet of column 22 (FIG. 10), and the adsorbent phase is further coated on the collective surfaces of the detector cavity and components. The liquid phase is introduced by filling the column detector and injector train with the selected liquid phase with conventional coating technology used for open tubular columns, using vacuum for backfill in the small sized cavities and channels. The liquid phase is evaporated from the hot wire by electrically bringing the filament to elevated temperature. With this arrangement the detector becomes an integral part of the column, thereby eliminating dead volume and increasing precision of chromatography peaks. (Goedert at col. 9:25-49, emphasis added).

Thus, the cited combination of Craig in view of Goedert fails to teach each and every element of the claimed invention. Accordingly, it is believed that the claims are in condition for allowance, and the outstanding rejections under 35 U.S.C. § 103(a) may properly be withdrawn.

CONCLUSION

In view of the above, each of the presently pending claims in this application is believed to be in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to withdraw the outstanding rejection of the claims and to pass this application to issue. If it is determined that a telephone conference would expedite the prosecution of this application, the Examiner is invited to telephone the undersigned at the number given below.

In the event the U.S. Patent and Trademark office determines that an extension and/or other relief is required, applicant petitions for any required relief including extensions of time and authorizes the Commissioner to charge the cost of such petitions and/or other fees due in connection with the filing of this document to **Deposit Account No. 03-1952** referencing docket No. 514572000500. However, the Commissioner is not authorized to charge the cost of the issue fee to the Deposit Account.

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